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## A study of transitive closure as a recursion mechanism

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Pages: 331 - 344

Year of Publication: 1987

ISSN:0163-5808

[Also published in ....](#)

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### Publisher

[ACM](#) New York, NY, USA

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## ABSTRACT

We show that every linearly recursive query can be expressed as a transitive closure possibly preceded and followed by operations already available in relational algebra. This reduction is possible even if there are repeated variables in the recursive literals and if some of the arguments in the recursive literals are constants. Such an equivalence has significant theoretical and practical ramifications. On the one hand it influences the design of expressive notations to capture recursion as an augmentation of relational query languages. On the other hand implementation of deductive databases is impacted in that the design does not have to provide the generality that linear recursion would demand. It suffices to study the single problem of transitive closure and to provide an efficient implementation for it.



## ↑ REFERENCES

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- 1  Herve Gallaire , Jack Minker , Jean-Marie Nicolas, Logic and Databases: A Deductive Approach, ACM Computing Surveys (CSUR), v.16 n.2, p.153-185, June 1984  
[doi> [10.1145/356924.356929](https://doi.org/10.1145/356924.356929)]
- 2  Francois Bancilhon , Raghu Ramakrishnan, An amateur's introduction to recursive query processing strategies, Proceedings of the 1986 ACM SIGMOD international conference on Management of data, p.16-52, May 28-30, 1986, Washington, D.C., United States
- 3  Lawrence J. Henschen , Shamim A. Nagvi, On compiling queries in recursive first-order databases, Journal of the ACM (JACM), v.31 n.1, p.47-85, Jan. 1984  
[doi> [10.1145/2422.2423](https://doi.org/10.1145/2422.2423)]
- 4 F Bancilhon Naive Evaluation of Recursively Defined Relations Tech Rept DB-004-85 MCC Austin Texas 1985
- 5 Y E Ioannidis A Time Bound on the Materialization of Some Recursively Defined Views Proc 11th Int'l Conf Ver# Large Data Base# Stockholm Sweden Aug 1985 219-226
- 6  Francois Bancilhon , David Maier , Yehoshua Sagiv , Jeffrey D Ullman, Magic sets and other strange ways to implement logic programs (extended abstract), Proceedings of the fifth ACM SIGACT-SIGMOD symposium on Principles of database systems, p.1-15, March 24-26, 1986, Cambridge, Massachusetts, United States  
[doi> [10.1145/6012.15399](https://doi.org/10.1145/6012.15399)]
- 7  Jeff Naughton, Data independent recursion in deductive databases, Proceedings of the fifth ACM SIGACT-SIGMOD symposium on Principles of database systems, p.267-279, March 24-26, 1986, Cambridge, Massachusetts, United States  
[doi> [10.1145/6012.15420](https://doi.org/10.1145/6012.15420)]
- 8 Y E Ioannidis and E Wong. An Algebraic Approach to Recursive Inference Proc 1st Int'l Conf Expert Database Sy#tem# Charleston South Carolina April 1986 209-224
- 9 P Devanbu and R Agrawal Moving Selections into a Class of Least Fixpoint Queries AT&T Bell Laboratories Technical Memorandum 1986
- 10 P Valdenez and H Boral Evaluation of Recursive Queries Using Join Indices Proc 1st Int'l Conf Expert Database Sy#tem, Charleston South Carolina Aprd 1986 197-208
- 11 Yannis E. Ioannidis, On the Computation of the Transitive Closure of Relational Operators, Proceedings of the 12th International Conference on Very Large Data Bases, p.403-411, August 25-28, 1986

- 12 [Rakesh Agrawal , H. V. Jagadish, Direct Algorithms for Computing the Transitive Closure of Database Relations, Proceedings of the 13th International Conference on Very Large Data Bases, p.255-266, September 01-04, 1987](#)
-  13 [Stephen Warshall, A Theorem on Boolean Matrices, Journal of the ACM \(JACM\), v.9 n.1, p.11-12, Jan. 1962. \[doi> 10.1145/321105.321107\]](#)
- 14 L E Thorelh An Algorithm for Computing All Paths in a Graph BIT 6 (1966) 347-349
- 15 P Purdom A Transitive Closure Algorithm BIT 10 (1970) 76-94
-  16 [Henry S. Warren, Jr., A modification of Warshall's algorithm for the transitive closure of binary relations, Communications of the ACM, v.18 n.4, p.218-220, April 1975. \[doi> 10.1145/360715.360746\]](#)
- 17 C P Schnorr An Algorithm for Transiue Closure v#lth Linear Expected Time SIAM J Computing 7 2 (May 1978) 127-133
- 18 [Rakesh Agrawal, Alpha: An Extension of Relational Algebra to Express a Class of Recursive Queries, Proceedings of the Third International Conference on Data Engineering, p.580-590, February 03-05, 1987](#)
-  19 [E. F. Codd, A relational model of data for large shared data banks, Communications of the ACM, v.13 n.6, p.377-387, June 1970. \[doi> 10.1145/362384.362685\]](#)
- 20 [Michael Kifer , Eliezer L. Lozinskii, Filtering data flow in deductive databases, Proceedings on International conference on database theory, p.186-202, December 1986, Rome, Italy](#)
- 21 [Hongjun Lu , Krishna P. Mikkilineni , James P. Richardson, Design and Evaluation of Algorithms to Compute the Transitive Closure of a Database Relation, Proceedings of the Third International Conference on Data Engineering, p.112-119, February 03-05, 1987](#)

↑ CITED BY 28

-  [Kalervo Järvelin , Timo Niemi, Data conversion, aggregation and deduction for advanced retrieval from the heterogeneous fact databases, Proceedings of the 14th annual international ACM SIGIR conference on Research and development in information retrieval, p.173-182, October 13-16, 1991, Chicago, Illinois, United States](#)
  -  [David A. Briggs, A correction of the termination conditions of the Henschen-Nagvi technique, Journal of the ACM \(JACM\), v.37 n.4, p.711-719, Oct. 1990](#)
- [Rakesh Agrawal , H. V. Jagadish, Direct Algorithms for Computing the Transitive Closure of Database Relations, Proceedings of the 13th International Conference on Very Large Data Bases, p.255-266, September 01-04, 1987](#)



Ming-Chien Shan , Marie-Anne Neimat, Optimization of relational algebra expressions containing recursion operators, Proceedings of the 19th annual conference on Computer Science, p.332-341, April 1991, San Antonio, Texas, United States



Seppo Sippu , Elias Soisalon-Soininen, A generalized transitive closure for relational queries, Proceedings of the seventh ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, p.325-332, March 1988, Austin, Texas, United States

W. Lu , D. L. Lee , J. Han, A Study on the Structure of Linear Recursion, IEEE Transactions on Knowledge and Data Engineering, v.6 n.5, p.723-737, October 1994

Jiawei Han, Chain-Split Evaluation in Deductive Databases, IEEE Transactions on Knowledge and Data Engineering, v.7 n.2, p.261-273, April 1995

C. Youn , H. -J. Kim , L. J. Henschen , J. Han, Classification and Compilation of Linear Recursive Queries in Deductive Databases, IEEE Transactions on Knowledge and Data Engineering, v.4 n.1, p.52-67, February 1992

Rakesh Agrawal , H. V. Jagadish, Hybrid Transitive Closure Algorithms, Proceedings of the 16th International Conference on Very Large Data Bases, p.326-334, August 13-16, 1990



Thane Plambeck, Semigroup techniques in recursive query optimization, Proceedings of the ninth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, p.145-153, April 02-04, 1990, Nashville, Tennessee, United States



Håkan Jakobsson, On tree-based techniques for query evaluation, Proceedings of the eleventh ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, p.380-392, June 02-05, 1992, San Diego, California, United States



Yun-Wu Huang , Ning Jing , Elke A. Rundensteiner, Path queries for transportation networks: dynamic reordering and sliding window paging techniques, Proceedings of the 4th ACM international workshop on Advances in geographic information systems, p.9-16, November 1996, Rockville, Maryland, United States



Mariano P. Consens , Alberto O. Mendelzon, GraphLog: a visual formalism for real life recursion, Proceedings of the ninth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, p.404-416, April 02-04, 1990, Nashville, Tennessee, United States


R. Ahad , S. Bing Yao, RQL: A Recursive Query Language, IEEE Transactions on Knowledge and Data Engineering, v.5 n.3, p.451-461, June 1993

Sakti Pramanik , Sungwon Jung, Description and Identification of Distributed Fragments of Recursive Relations, IEEE Transactions on Knowledge and Data Engineering, v.8 n.6, p.1002-1016, December 1996

R. Agrawal , H. V. Jagadish, Multiprocessor transitive closure algorithms, Proceedings of the first international symposium on Databases in parallel and distributed systems, p.56-66, December 05-07, 1988, Austin, Texas, United States

R. Agrawal , P. Devanbu, Moving Selections into Linear Least Fixpoint Queries, IEEE Transactions on Knowledge and Data Engineering, v.1 n.4, p.424-432, December 1989.

K. -C. Guh , C. Yu, Efficient Management of Materialized Generalized Transitive Closure in Centralized and Parallel Environments, IEEE Transactions on Knowledge and Data Engineering, v.4 n.4, p.371-381, August 1992.


 Weining Zhang , Clement T. Yu , Daniel Troy, Necessary and sufficient conditions to linearize doubly recursive programs in logic databases, ACM Transactions on Database Systems (TODS), v.15 n.3, p.459-482, Sept. 1990.


Maurice A. W. Houtsma , Peter M. G. Apers , Stefano Ceri, Distributed Transitive Closure Computations: The Disconnection Set Approach, Proceedings of the 16th International Conference on Very Large Data Bases, p.335-346, August 13-16, 1990.

K. -C. Guh , C. Yu, Efficient Query Processing for a Subset of Linear Recursive Binary Rules, IEEE Transactions on Knowledge and Data Engineering, v.6 n.5, p.842-849, October 1994.


Rakesh Agrawal, Alpha: An Extension of Relational Algebra to Express a Class of Recursive Queries, IEEE Transactions on Software Engineering, v.14 n.7, p.879-885, July 1988.


Leo Mark , Roberta Cochrane, Grammars and Relations, IEEE Transactions on Software Engineering, v.18 n.9, p.840-849, September 1992.

 H. V. Jagadish, A compression technique to materialize transitive closure, ACM Transactions on Database Systems (TODS), v.15 n.4, p.558-598, Dec. 1990.

 Rakesh Agrawal , Shaul Dar , H. V. Jagadish, Direct transitive closure algorithms: design and performance evaluation, ACM Transactions on Database Systems (TODS), v.15 n.3, p.427-458, Sept. 1990.

Timo Niemi , Kalervo Järvelin, Prolog-Based Meta-rules for Relational Database Representation and Manipulation, IEEE Transactions on Software Engineering, v.17 n.8, p.762-788, August 1991.

 Mihalis Yannakakis, Graph-theoretic methods in database theory, Proceedings of the ninth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems, p.230-242, April 02-04, 1990, Nashville, Tennessee, United States.

 Domenico Beneventano , Sonia Bergamaschi , Claudio Sartori, Description logics for semantic query optimization in object-oriented database systems, ACM Transactions on Database Systems (TODS), v.28 n.1, p.1-50, March 2003.

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